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ABSTRACT

This orientation module for the Basic Electric/Electronics Individualized Learning System (BEEINLES) was designed to familiarize the individual with this new learning experience. The module is divided into six lessons: your rating (a brief discussion of each of the job categories); what an individualized learning system is; the BEEINLES multimedia study area and some of its new and innovative equipment (a description of the resource center, module booklets--with their summaries, narratives, programed instruction, and the slide-sound equipment); the testing program (an explanation of the three types of tests given--progress checks, module checks, and the comprehensive examination); safety education (indicates some of the major hazards encountered in the normal working conditions of the technician); and building your power supply (how to construct your own power source before you start your formal study of the basic electronics and electricity course). (Author/BP)

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BASIC ELECTRICITY AND ELECTRONICS

INDIVIDUALIZED LEARNING SYSTEM

MODULE ZERO

ORIENTATION

Study Booklet

BUREAU OF NAVAL PERSONNEL

January 1972

CE002574

O V E R V I E W
MODULE ZERO
ORIENTATION

In order for you to reach maximum efficiency in the BEEINLES course, you should be familiar with the components making up the individualized system. The purpose of the orientation module is to help you as an individual get started in this new learning experience.

This module has been divided into the following six lessons:

Lesson I.	Your Rating
Lesson II.	What an Individualized Learning System Is
Lesson III.	The BEEINLES Multi-Media Study Area, and some of its new and innovative equipment
Lesson IV.	The Testing Program
Lesson V.	Safety Precautions
Lesson VI.	Building Your Power Supply

NAVPERS 94558-0a

BASIC ELECTRICITY AND ELECTRONICS
INDIVIDUALIZED LEARNING SYSTEM

M O D U L E Z E R O
L E S S O N 1

Your Rating

Study Booklet

Bureau of Naval Personnel
January 1972

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OVERVIEW

LESSON 1

Your Rating

Upon graduation from BE/E, you will enter a follow-on Class "A" school, and then either directly, or after Class "C" school, will go to your duty station in one of the following job categories:

-Electrician's Mate (EM)
-Interior Communication Electrician (IC)
-Electronics Technician (ET)
-Data Systems Technician (DS)
-Sonar Technician (ST)
-Communications Technician (CT)
-Electronics Warfare (EW)
-Torpedoman's Mate (TM)
-Ocean Systems Technician (OT)
-Fire Control Technician (FT)
-Communications Technician (CTM)
-Aviation Electrician's Mate (AE)
-AV A School
-Gunner's Mate (GM)

Here is a very brief discussion of each of the ratings.

ORIENTATION

LESSON I

Your Rating

Electrician's Mate (EM) (EM A School, San Diego and Great Lakes)

Electrician's Mates stand watch on generators, switchboards, and control equipment; operate electrical equipment; maintain and repair power and lighting circuits, electrical fixtures, motors, generators, distribution switchboards, and other electrical equipment; test for short circuits, grounds, or other casualties; and repair and rebuild electrical equipment in an electrical shop.

Interior Communications Electrician (IC) (IC A School, San Diego)

Interior Communications Electricians operate, maintain, and repair interior communications (IC) systems including gyrocompass, voice interior communications, alarm, warning, ship's control, entertainment, and associated equipment.

Electronics Technician (ET) (ET A School, Treasure Island and Great Lakes)

Electronics Technicians maintain, repair, calibrate, align, and adjust electronic equipment used for communication, detection, tracking, recognition and identification, aids to navigation, and electronic warfare. (Exceptions: airborne equipment, data transmission systems, interior communications systems, teletypewriter machines, sonar, and weapons control systems.) Performs administrative tasks associated with routine maintenance.

Data Systems Technician (DS) (DS A School, Mare Island)

Data Systems Technicians maintain electronic digital data systems and equipment; inspect, test, calibrate, and repair computers, tape units, buffer equipment, "input-output" devices, and related equipment; test and maintain test equipment; and prepare and use programmed test routines.

Sonar Technician (ST) (ST A School, San Diego and Keywest)

Sonar Technicians obtain and interpret underwater data for operational use; supervise the use and upkeep of sonar equipment; organize antisubmarine (A/S) attack teams; train and supervise personnel in their assignments; evaluate targets and interpret oceanographic data; evaluate equipment operation; locate and analyze equipment casualties and make repairs and adjustments; align, maintain, and repair surface ship underwater fire control systems; and train personnel in all categories of equipment.

Communications Technician (CT) (ET A School, Treasure Island and Great Lakes)

Communications Technicians perform specialized communication duties under cognizance of the Chief of Naval Operations (DNC). Qualifications for advancement in this rating are issued separately. Communications Technicians are not to be assigned to, or included in allowances of installations other than Naval Security Group activities and the National Security Agency. Distribution of information regarding their qualifications is limited to such as may be recommended by the Chief of Naval Operations.

Ocean Systems Technician (OT) (OT A School, Keywest, Florida)

Ocean Systems Technicians operate special oceanographic equipments to interpret and document the data received and displayed. They convert the displays into digital data and report significant features of this data to officers in charge so that it can be transcribed and forwarded to the necessary seniors in their organizational structure. They prepare the necessary data for use by similar commands and for training programs within the Oceanographic Systems. They perform operational and technical maintenance of the special equipments employed, using tools and testing devices commonly employed in electronics service work.

Electronics Warfare Technician (EW) (EW School, Treasure Island)

Electronics Warfare Technicians operate and perform organizational and intermediate level maintenance on ESM (Electronic Support Measures), ECM (Electronic Countermeasures), and associated supporting equipment; extract, interpret and apply data from intelligence publications, reports and other documentation; evaluate, interpret, and determine equipment capabilities and limitations; evaluate, interpret, process, and apply intercepted signal data, ELINT (Electronic Intelligence) reports and EW (Electronic Warfare) Tactics and doctrine to operational needs; train and supervise personnel in EW assignments; supervise the preparation of electronic warfare reports; inform EWO (Electronic Warfare Officer) and/or the CIC (Combat Information Center) Officer concerning the nature of threat signals and recommend appropriate countermeasures; serve as assistant to EWO.

Fire Control Technician (FT) (FT A School, Great Lakes and Vallejo)

Fire Control Technicians perform organizational and intermediate level maintenance on weapons control equipment; operate, test, maintain, and repair weapons control systems and launchers; perform missile testing, make detailed mechanical, electrical, and electronic casualty analysis; and maintain and repair associated test equipment.

Torpedoman's Mate (TM) (TM A School, Orlando, Florida)

Torpedoman's Mates perform organizational and intermediate level maintenance on underwater ordnance such as torpedoes and anti-submarine rockets (SUBROC/ASROC), launched from surface ships, submarines, and aircraft; operate and maintain test equipment, launching/firing systems, and stowage facilities associated with underwater ordnance, prepare underwater ordnance for launching; and conduct postfiring routines, and securing and evaluation procedures.

When assigned to perform intermediate level maintenance, Torpedoman's Mates maintain, test, repair, and overhaul underwater ordnance launched from surface ships, submarines, and aircraft; supervise stowage of underwater ordnance; test and maintain ordnance test equipment; prepare weapons in either exercise or warhead configuration; and conduct post-firing routines and evaluations (including tape analysis).

Communications Technician (CTM) (ET A School, Treasure Island and Great Lakes)

Communications Technician (M) or Maintenance Branch personnel maintain, repair, and calibrate standard and specialized electronic and electromechanical equipment, including computers hardware and software; transmitters and receivers, and TTY and Associated equipment used by activities of the Naval Security Group Command. Additionally, CTM personnel are occasionally called upon to install, maintain and evaluate newly developed electronic communications equipment. Qualified CT's of the M Branch who are trained and specifically authorized also perform maintenance on cryptographic devices.

Aviation Electrician's Mate (AE) (AE A School, NAS Jacksonville)

It is the responsibility of the AE to inspect and maintain aircraft electrical and instrument systems, including: power generation, electrical components of aircraft controls, aircraft electrical starting systems, automatic pilots, and inertial navigation systems.

Avionics Technician Class A School, (AV A School, Memphis)

Upon completion of BEEINLES, personnel will be transferred to NAS Memphis for 2 weeks Aviation Familiarization and 15 weeks Avionics Technician A School. During the course you will be assigned to one of the following rates:

Aviation Electronics Technician (AT)

It is the responsibility of the AT to maintain the radar, radio, and navigational systems aboard aircraft, target drones, and pilotless aircraft.

Aviation Fire Control Technician (AQ)

AQ's inspect and perform organizational and intermediate maintenance on various aircraft weapons systems.

Aviation Antisubmarine Warfare Technician (AX)

It is the responsibility of the AX to inspect and maintain aircraft antisubmarine warfare systems and equipment.

Tradevman (TD)

Tradevman install, repair, modify, operate and maintain audio/visual training aids and training devices.

Gunner's Mate G (Guns) - GMG (GM A School, Great Lakes)

Gunner's Mates (G) operate, maintain, and repair guns, gun mounts, turrets, rocket launchers, projectors, associated handling equipment, and small arms; make detailed electrical, electronic, hydraulic, and mechanical casualty analyses; maintain and repair electric, electronic, hydraulic, and mechanical systems and servosystems in guns, gun mounts, gun turrets, rocket launchers, projectors, and associated handling equipment; test and inspect gun and rocket ammunition; test, inspect and maintain magazine sprinkler systems; supervise personnel in the handling and stowage of gun and rocket ammunition; and direct crews in the operation of guns, gun mounts, gun turrets, rocket launchers, ammunition hoists and handling rooms, and projectors.

Gunner's Mate M (Missiles) - GMM (GM A School, Great Lakes)

Gunner's Mates (M) operate, maintain, and repair guided-missile launching systems, missile launching groups, and associated handling equipment; make detailed electrical, electronic, hydraulic, and mechanical casualty analyses; maintain and repair electric, electronic, hydraulic, and mechanical systems and servosystems in missile launching systems, launching groups, and associated handling equipment; assemble and inspect missiles; prepare missiles for testing; replace defective components and modules; repair nonelectronic components of missiles; handle and stow missiles and missile components; test, inspect, and maintain magazine sprinkler systems; supervise personnel in the handling and stowage of missile and missile components; and direct wing and fin assemblymen in the duties of their stations.

Gunner's Mate T (Technician) - GMT (GM A School, Great Lakes)

Gunner's Mates (T) store, inspect, test, adjust, maintain, repair, and package nuclear weapon components and associated equipment; assemble, disassemble, and convert nuclear weapons, warheads, and/or components.

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BASIC ELECTRICITY AND ELECTRONICS
INDIVIDUALIZED LEARNING SYSTEM

MODULE ZERO
LESSON II

What an Individualized Learning System Is

Study Booklet

Bureau of Naval Personnel
January 1972

ORIENTATION

LESSON II

What an Individualized Learning System Is

You are about to begin an individualized learning course in basic electricity and electronics. This will be a different kind of course from those you have experienced in the past. As you can see by looking around you, each of you has a private carrel rather than a desk facing the learning supervisor. Instead of giving a class assignment, the learning supervisor will give each of you a module kit which will tell you what you need to learn and what materials are available for study. It will also have Progress Checks. These are self-tests to help you determine when you have mastered the relevant concepts. For example, the module kit may tell you that you need to know what is meant by electricity and how an electric current runs through a solid wire. In addition, it will tell you that this information can be found in the Summary, Narrative, Programmed Instruction, a sound/slide presentation or in a 8mm movie film.

Once you know what resources are available to you, the decisions about which ones to use will be up to you. The whole class does not do the same thing at the same time. Each of you should choose the material and the method of presenting the material (medium) that is best suited to your particular needs or learning style. You will also decide when to take the Progress Checks and the Module test. You do not have to take them when anyone else does. Once you have successfully "passed" the module test, you should go on to the next module (There are 16 of them 0 through 15). At first, you may feel a little uneasy about having to make all of these decisions instead of having someone else make them for you, but after a few days, it should become easy. The whole point of this instructional system is to allow you to become involved in the kind of decisions that are usually made by someone else when, in reality, you are the one person in the best position to make them.

Pointers for Students

READ ALL INSTRUCTIONS CAREFULLY. Many silly mistakes and much confusion arise when people do not read instructions or read them carelessly. Don't let yourself fall into that trap.

LEARN WELL. In a non-individualized course, it is possible to "slide by" without learning all the points in a lesson, because when the class moves to the next lesson, everyone has to move on. In this course, progress from one module to the next depends on your being able to meet the objectives of each module regardless of what anyone else is doing. Therefore, it is to your advantage to learn the information well before you take the test.

BE SELF-RELIANT. In a non-individualized course, the instructor tells you exactly what to do and when to do it. In this course, you make most of these decisions for yourself. You may feel uncomfortable or uncertain of yourself at first. You may want to ask your learning supervisor: "What should I do now?", but, although your instructor is there to help you, you should only go to him for this kind of information as a last resort. After you have successfully completed a few tasks on your own, your confidence will increase and you will begin to feel comfortable in an individualized classroom.

USE WHAT IS AVAILABLE. In this course, there are at least two and often more kinds of materials which you can study to learn a particular concept. If you have studied one kind of material and you still don't understand something, don't give up or study the same material again. Try studying one of the other kinds of material. For instance, if you have read the Narrative and don't understand what it was all about, you might try the Programmed sequence or the audio-visual presentations. If you have tried alternative material and something is still unclear, ask for help.

COMPETE AGAINST YOURSELF. You are not competing against any other student. It does not matter how well or how fast others achieve. Set your own goals. This course is similar to mountain climbing. In other words, it is you against the mountain. When you get to the top you will know that you met the challenge and won.

NAVPERS 94558-0a

BASIC ELECTRICITY AND ELECTRONICS
INDIVIDUALIZED LEARNING SYSTEM

M O D U L E Z E R O
L E S S O N I I I

Multi-Media:
What's Available and How to Use It.

Study Booklet

Bureau of Naval Personnel
January 1972

ORIENTATION

LESSON III

Multi-Media: What's Available and How To Use It.

The Basic Electricity/Electronics Individualized Learning System (BEEINLES) study area was designed to provide each student with as much privacy and convenience as possible. You will be able to study, perform experiments, and view audio-visual programs at your study station.

There are small areas set aside in which you can hold group discussion, talk to a learning supervisor, or just relax.

The Resource Center will house the written materials, electrical components, and special equipment needed for study. BEEINLES will offer you a variety of choices. In the Module Booklets, the information you will need to study will be written in three different ways:

Summary. The summary is a condensed version of the lesson. You can quickly read the summary and get an overall picture of what the lesson is all about. If you already have a knowledge of electricity, you may be able to go directly from the Summary to the lesson Progress Check. All students should begin each lesson by reading the Overview.

Narrative. The sections titled "Narrative" are very much like the textbooks you studied in high school. This presentation goes into much more detail than the Summary.

Programmed Instruction. The other choice in written materials is Programmed Instruction (PI). In the PI, the essential information is broken down into small steps. The student is required to make many responses, and thus, he learns by doing.

In addition to the written materials, BEEINLES will offer you a variety of programs by sound/slide and 8mm film. These programs are listed for you at the beginning of each lesson in the section titled "Study Resources." Before you begin the first one of these special programs, you must receive instruction on the equipment from the learning supervisor or a student who has already used it.

In the first module or two, you should probably go through all types of the material to become familiar with the different styles. As you go through the course, try to determine for yourself which style fits you best.

When you finish each lesson, you should take the lesson Progress Check and correct it. You may take this test at any time you feel you are ready. As a matter of fact, you may feel free to look over the Progress Check even before you begin to study the lesson.

All lessons or parts dealing with a major concept are bound together to form a Module. After you have completed all of the lessons in a Module and you are certain that you are prepared to take the Module Test, you should tell the learning supervisor you are ready.

Response Sheets. Along with the learning materials you will be given separate response sheets. These are to be used to answer questions, draw diagrams, solve problems, and respond to frames in the Programmed Instruction. It is very important that you make written responses to the questions and frames. The very act of writing the answers will help you learn better and remember longer. It is recommended that you use a 5 x 8 card or sheet of paper to cover the answers as you go through the materials.

SLIDE/SOUND SYSTEM

Most of the audio-visual presentations you have the option to take will be in a slide/sound format, combining the use of a slide projector and a cassette tape recorder.

Perhaps the most significant reason for using this medium in an individualized system like yours is that you have complete control over the presentation. You control the tape recorder which delivers the narration, and you control the changing of slides on signal.

Among the many advantages of this format is the ease with which a lesson can be updated or modified. You can feel confident that what you are seeing and hearing is accurate and up to date.

Equipment

Slide/sound presentations require the use of a tape recorder and a 35mm slide projector. Both pieces of equipment are simple to operate, but if you have never used these particular models before, get checked out by your Learning Supervisor or a qualified student before you do the first Slide/Sound lesson.

35mm Slide Projector

You may already know how to operate a Kodak Carousel Projector. If you don't, you can learn easily.

1. First, the switch on the back of the projector that turns it on and off has four positions. The LOW setting should be used for the carrel. The other positions' functions are obvious.

2. After you have your recorder set up for operation, you should prepare the projector. If you don't know how to do this, a qualified student will show you how to set up and secure the projector.

3. After you have been checked out, present the first slide which reads "Basic Electricity and Electronics Presents---" on the screen. Put on the recorder headset, start the recorder, and change slides by pushing the AHEAD button each time you hear a tone signal. If you follow these simple directions, the slides and tape will be synchronized. However, if you are out of synchronization and cannot get back in easily, rewind the tape, get the first slide on the screen, and start again.

4. During the lesson, you can control the learning rate by stopping the tape recorder any time you wish to study a picture - just push the STOP button. When you are ready to proceed, push the PLAY button and change the slides (AHEAD) when you hear the tone.

5. When you have finished viewing a slide/sound presentation one or more times, rewind the tape; remove the headset and the casette; hold the SELECT button down and realign the tray to the ZERO mark; put the projector switch in the OFF position; unplug the power cord; and return all equipment and material to the proper stowage in the resource center.

INFORM THE LEARNING SUPERVISOR OR RESOURCE COORDINATOR OF ANY EQUIPMENT MALFUNCTION!

Don't hesitate to ask questions, and be sure you stop the recorder whenever you like.

If a piece of A/V equipment has a malfunction while you are using it, NOTIFY THE RESOURCE COORDINATOR. Do not attempt even minor repairs of A/V equipment yourself. Be sure you report any malfunction so that the equipment can be repaired and used again as soon as possible.

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BASIC ELECTRICITY AND ELECTRONICS
INDIVIDUALIZED LEARNING SYSTEM

M O D U L E Z E R O

L E S S O N I V

The Testing Program

Study Booklet

Bureau of Naval Personnel
January 1972

ORIENTATION

LESSON IV

The Testing Program

There are three different types of tests in the program. These are the lesson progress checks, the module tests, and the comprehensive examination.

Progress Checks

You will receive a booklet of lesson tests with each module. You may review these tests before you begin reading the materials if you wish. When you finish each lesson you should answer all the questions on the self-test and check the answers yourself. If you miss a question you should go back and re-study that portion. If you miss several questions you might need to re-study the entire lesson, perhaps through another media. It is up to you to determine if you have mastered the lesson.

Module Tests

The module test covers all of the lessons in a module booklet. It is your responsibility to draw the module test and the answer card from a place so designated in the learning center. When you have completed the test, take both the test and card back for scoring. Unless you are told otherwise, you may score the test yourself by using an overlay or with a grading machine if your learning center is so equipped. Return the test after it has been scored, and bring your answer card to your learning supervisor. If it appears that you are weak in any part of the module you and the learning supervisor will plan how you should review the materials.

You will not receive a numerical grade.

You should pass the critical test items. You will not know which items are considered to be critical until after you have taken the test. You will not be compared with other students. The test results will be used exclusively to determine whether you have met the learning objectives and to prescribe the next appropriate learning activity. If you pass each Module Test, you can assume that you are doing very well.

Comprehensive Examination

The comprehensive or final examination covers learning objectives from all of the modules. This test is given before you begin and after you have finished the modules. In this way, it can be determined how much you learned in the course.

Again, you will not be given a "grade" on the test; it will be used to determine whether you are well enough prepared to go on to your designated A School and to prescribe any review that may be necessary.

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BASIC ELECTRICITY AND ELECTRONICS
INDIVIDUALIZED LEARNING SYSTEM

MODULE ZERO

LESSON V

Safety Precautions

Study Booklet

Bureau of Naval Personnel
January 1972

ORIENTATION

LESSON V

Safety Precautions

In the performance of his normal duties, the technician is exposed to many potentially dangerous conditions and situations. No training manual, no set of rules or regulations, no listing of hazards can make working conditions completely safe. However, it is possible for the technician to complete a full career without serious accident or injury. Attainment of this goal requires that he be aware of the main sources of danger, and that he remain constantly alert to those dangers. He must take the proper precautions and practice the basic rules of safety. He must be safety conscious at all times, and this safety consciousness must become second nature to him.

Much pertinent safety information is contained in Rate Training Manuals. Of particular worth is the Standard First Aid Training Course, NavPers 10081-B. In addition, directives concerning safety are published by all major commands on those specific hazards and procedures falling under the cognizance of those commands. The Chief of Naval Operations has issued a listing of specific safety precautions compiled by the Navy Department. This publication cross references safety directives by subject matter and by the identifying designation.

The purpose of this lesson is to indicate some of the major hazards encountered in the normal working conditions of the technician, and to indicate some of the basic precautions that must be observed. Although many of these hazards and precautions are general and apply to all personnel, some of them are peculiar or especially applicable to personnel concerned with electrical and electronic maintenance.

Most accidents which occur in noncombat operations can be prevented if the full cooperation of personnel is gained, and if care is exercised to eliminate unsafe acts and conditions. In the following paragraphs, some general safety rules are listed. These rules apply to personnel in all types of activities, and each individual should strictly observe the following precautions as applicable to his work or duty:

1. Report any unsafe condition or any equipment or material which he considers to be unsafe.

2. Warn others whom he believes to be endangered by known hazards or by failure to observe safety precautions.

3. Wear or use available protective clothing or equipment of the type approved for safe performance of his work or duty.

4. Report any injury or evidence of impaired health occurring in the course of work or duty.

5. Exercise, in the event of any unforeseen hazardous occurrence, such reasonable caution as is appropriate to the situation.

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Electrical Safety Precautions

Safety precautions in this lesson are not intented to replace information given in instructions or maintenance manuals. If at any time there is doubt as to what steps and procedures to follow, consult the leading petty officer.

Effects of Electric Shock

The amount of current that may pass through the body without danger depends on the individual and the current quantity, type, path, and length of contact time.

Body resistance varies from 1,000 to 500,000 ohms for unbroken, dry skin. (Resistance and its unit of measurement are discussed in later modules.) Resistance is lowered by moisture and high voltage, and is highest with dry skin and low voltage. Breaks, cuts, or burns may lower body resistance. A current of 1 milliampere can be felt and will cause a person to avoid it. (The term milliampere is discussed in a later module; however, for this discussion it is sufficient to define milliampere as a very small amount of current or 1/1,000 of an ampere.) Current as low as 5 milliamperes can be dangerous. If the palm of the hand makes contact with the conductor, a current of about 12 milliamperes will tend to cause the hand muscles to contract, freezing the body to the conductor. Such a shock may or may not cause serious damage, depending on the contact time and your physical condition, particularly the condition of your heart. A current of only 25 milliamperes has been known to be fatal; 100 milliamperes is likely to be fatal.

Due to the physiological and chemical nature of the human body, five times more direct current than alternating current is needed to freeze the same body to a conductor. Also, 60 hertz (cycles per second) alternating current is about the most dangerous frequency. This is normally used in residential, commercial, and industrial power.

The damage from shock is also proportional to the number of vital organs transversed, especially the percentage of current that reaches the heart.

Currents between 100 and 200 milliamperes are lethal. Ventricular fibrillation of the heart occurs when the current through the body approaches 100 milliamperes. Ventricular fibrillation is the uncoordinated actions of the walls of the heart's ventricles. This in turn causes the loss of the pumping action of the heart. This fibrillation will usually continue until some force is used to restore the coordination of the heart's action.

Severe burns and unconsciousness are also produced by currents of 200 milliamperes or higher. These currents usually do not cause death if the victim is given immediate attention. The victim will usually respond if rendered resuscitation in the form of artificial respiration. This is due to the 200 milliamperes of current clamping the heart muscles which prevents the heart from going into ventricular fibrillation.

When a person is rendered unconscious by a current passing through the body, it is impossible to tell how much current caused the unconsciousness. Artificial respiration must be applied immediately if breathing has stopped.

High Voltage Safety Precautions

It is human nature to become careless with routine procedures. To illustrate the results of unsafe practices and to reemphasize the need for good safety habits, particularly around high voltage or high current circuits, consider the following incident.

A technician was electrocuted while attempting to bypass an interlock circuit in the vicinity of high voltages on a piece of electrical equipment. This was the direct result of violating a basic safety practice and indirectly an individual lack of equipment knowledge.

Many pieces of electrical equipment employ voltages which are dangerous and may be fatal if contacted. Practical safety precautions have been incorporated into electrical systems; when the most basic rules of safety are ignored, the built-in protection becomes useless.

The following rules are basic and should be followed at all times by all personnel when working with or near high voltage circuits:

1. CONSIDER THE RESULT OF EACH ACT - There is absolutely no reason for an individual to take chances that will endanger his life or the lives of others.

2. KEEP AWAY FROM LIVE CIRCUITS - Do not change parts or make adjustments inside the equipment with high voltages on.

3. DO NOT SERVICE ALONE - Always service equipment in the presence of another person capable of rendering assistance or first aid in an emergency.

4. DO NOT TAMPER WITH INTERLOCKS - Do not depend on interlocks for protection; always shut down equipment. Never remove, short circuit, or tamper with interlocks except to repair the switch.

5. DO NOT GROUND YOURSELF - Make sure you are not grounded when adjusting equipment or using measuring equipment. Use only one hand when servicing energized equipment. Keep the other hand behind you.

6. Do not energize equipment if there is any evidence of water leakage; repair the leak and wipe up the water before energizing.

These rules, teamed with the idea that voltage shows no favoritism and that personal caution is your greatest safeguard, may prevent serious injury or even death.

Working On Energized Circuits

Insofar as is practicable, repair work on energized circuits should not be undertaken. When repairs on operating equipment must be made because of emergency conditions, or when such repairs are considered to be essential, the work should be done only by experienced personnel, and if possible, under the supervision of a senior petty officer of the assigned shop. Every known safety precaution should be carefully observed. Ample light for good illumination should be provided; the worker should be insulated from ground with some suitable nonconducting material such as several layers of dry canvas, dry wood, or a rubber mat of approved construction. The worker should, if possible, use only one hand in accomplishing the necessary repairs. Helpers should be stationed near the main switch or the circuit breaker so that the equipment can be deenergized immediately in case of emergency. A man qualified in first aid for electric shock should stand by during the entire period of the repair.

Battery Safety Precautions

The principal hazard in connection with batteries is the danger of acid burns when refilling or when handling them. These burns can be prevented by the proper use of eyeshields, rubber gloves, rubber aprons, and rubber boots with nonslip soles. Rubber boots and apron need be worn only when batteries are being refilled. It is a good practice, however, to wear the eyeshield

whenever working around batteries to prevent the possibility of acid burns of the eyes. Wood slat floorboards, if kept in good condition, are helpful in preventing slips and falls as well as electric shock from the high-voltage side of charging equipment.

Another hazard is the danger of explosion due to the ignition of hydrogen gas given off during battery charging operation. This is especially true where the accelerated charging method is used. Open flames or smoking is prohibited in the battery charging room, and the charging rate should be held at a point that will prevent the rapid liberation of hydrogen gas. Manufacturers' recommendations as to the charging rates for various size batteries should be closely followed and a shop exhaust system should be used.

Particular care should be taken by technicians to prevent short circuits while batteries are being charged, tested, or handled. Hydrogen gas, which is accumulated while charging, is highly explosive and a spark from a shorted circuit could easily ignite the gas, causing serious damage to personnel and equipment.

Extreme caution should be exercised when installing and removing batteries. The nature of battery construction is such that the batteries are heavy for their size and are somewhat awkward to handle. These characteristics dictate the importance of using proper safety precautions. There is the possibility of acid causing damage to equipment or injury to personnel and the danger of an explosion that may be caused from the gas that is produced as the battery is charged. Follow the prescribed safety precautions in working with batteries.

Firefighting

In case of electrical fires, the following steps should be taken:

1. De-energize the circuit.
2. Call the Fire Department.
3. Control or extinguish the fire, using the correct type of fire extinguisher.
4. Report the fire to the appropriate authority.

For combating electrical fires, use a CO_2 (carbon dioxide) fire extinguisher and direct it toward the base of the flame. Carbon tetrachloride should never be used for firefighting since it changes to phosgene (a poisonous gas) upon contact with hot metal, and even in open air this creates a hazardous condition. The application of water to electrical fires is dangerous; the foam-type fire extinguishers should not be used since the foam is electrically conductive.

In cases of cable fires in which the inner layers of insulation or insulation covered by armor are burning, the only positive method of preventing the fire from running the length of the cable is to cut the cable and separate the two ends. All power to the cable should be secured and the cable should be cut with a wooden handled ax or insulated cable cutter. Keep clear of the ends after they have been cut.

Safety Precautions When Using Electrical Tools

As a general precaution, be sure that all tools used conform to Navy standards as to quality and type, and use them only for the purposes for which they were intended. All tools in active use should be maintained in good repair, and all damaged or nonworking tools should be turned in for repair or replacement.

When using a portable power drill, grasp it firmly during the operation to prevent it from bucking or breaking loose, thereby causing injury to yourself or damage to the tool.

Use only straight, undamaged, and properly sharpened drills. Tighten the drill securely in the chuck, using the key provided; never with wrenches or pliers. It is important that the drill be set straight and true in the chuck. The work should be firmly clamped and, if of metal a center punch should be used to score the material before the drilling operation is started.

In selecting a screwdriver for electrical work, be sure that it has a nonconducting handle. The screwdriver should not be used as a substitute for a punch or a chisel, and care should be taken that one is selected of the proper size to fit the screw.

When using a fuse puller, make certain that it is the proper type and size for the particular fuse being pulled.

The soldering iron is a fire hazard and a potential source of burns. Always assume that a soldering iron is hot; never rest the iron anywhere but on a metal surface or rack provided for that purpose. Keep the iron holder in the open to minimize the danger of fire from accumulated heat. Do not shake the iron to dispose of excess solder - a drop of hot solder may strike someone, or strike the equipment and cause a short circuit. Hold small soldering jobs with pliers or clamps.

When cleaning the iron, place the cleaning rag on a suitable surface and wipe the iron across it - do not hold the rag in the hand. Disconnect the iron when leaving the work, even for a short time - the delay may be longer than planned.

Electrical Hazards

Every person who works with electrical equipment should be constantly alert to the hazards of the equipment to which he may be exposed, and also be capable of rendering first aid to injured personnel. The installation, operation, and maintenance of electrical equipment requires enforcement of a stern safety code. Carelessness on the part of the operator or the maintenance technician can result in serious injury or death due to electric shock, falls, burns, flying objects, etc. After an accident has happened, investigation almost invariably shows that it could have been prevented by the exercising of simple safety precautions and procedures with which the personnel should have been familiar.

Each man concerned with electrical equipment should make it his personal responsibility to read and become thoroughly familiar with the safety practices and procedures contained in applicable safety directives, manuals, and other publications, and in equipment technical manuals prior to performing work on electrical equipment. It is the individual's responsibility to identify and eliminate unsafe conditions and unsafe acts which cause accidents.

Shock

Electric shock is a jarring, shaking sensation resulting from contact with electric circuits or from the effects of lightning. The victim usually feels that he has received a sudden blow; if the voltage and resulting current is sufficiently high, the victim may become unconscious. Severe burns may appear on the skin at the place of contact; muscular spasm may occur, causing the victim to clasp the apparatus or wire which caused the shock and be unable to turn it loose.

The following procedures are recommended for rescue and care of shock victims:

1. Remove the victim from electrical contact at once, but do not endanger yourself. This can be accomplished by: (1) throwing the switch if it is nearby; (2) cutting the cable or wires to the apparatus, using an ax with a wooden handle while taking care to protect your eyes from the flash when the wires are severed; (3) using a dry stick, rope, belt, coat, blanket, or any other nonconductor of electricity, to drag or push the victim to safety.

2. Determine whether the victim is breathing. Keep him lying down in a comfortable position and loosen the clothing about his neck, chest, and abdomen so that he can breath freely. Protect him from exposure to cold, and watch him carefully.

3. Keep him from moving about. In this condition, the heart is very weak, and any sudden muscular effort or activity on the part of the patient may result in heart failure.

4. Do not give stimulants or opiates. Send for a medical officer at once and do not leave the patient until he has adequate medical care.

5. If the victim is not breathing, it will be necessary to apply artificial respiration without delay, even though he may appear to be lifeless.

DO NOT STOP ARTIFICIAL RESPIRATION UNTIL MEDICAL AUTHORITY PRONOUNCES THE VICTIM BEYOND HELP.

For complete coverage on administering artificial respiration and treating burns, refer to Standard First Aid Training Course, NavPers 10081-B.

Safety Precautions

Take time to be safe when working on electrical circuits and equipment. Carefully study the schematics and wiring diagrams of the entire system, noting what circuits must be de-energized in addition to the main power supply. Remember that electrical equipment frequently has more than one source of power. Be certain that ALL power sources are de-energized before servicing the equipment. Do not service any equipment with the power on unless it is necessary.

It must be borne in mind that de-energizing main supply circuits by opening supply switches will not necessarily "kill" all circuits in a given piece of equipment. A source of danger that has often been neglected or ignored - sometimes with tragic results - is the inputs to electrical equipment from other sources, such as synchros, remote control circuits, etc. For example, turning off the antenna safety switches will disable the antenna, but it may not turn off the antenna synchro voltages from other sources. Moreover, the rescue of a victim shocked by the power input from a remote source is often hampered because of the time required to determine the source of power and turn it off. Therefore, turn off ALL power inputs before working on equipment.

Remember that the 120-volt power supply voltage is not low, relatively harmless voltage, but is the voltage that has caused more deaths in the Navy than any other.

Do NOT work with high voltage circuits alone; have another person (safety observer) who is qualified in first aid for electrical shock, present at all times. The man stationed nearby should also know the circuits and switches controlling the equipment, and should be given instructions to pull the switch immediately if anything unforeseen happens.

Always be aware of the nearness of high voltage lines or circuits. Use rubber gloves where applicable, and stand on approved rubber matting. Remember, not all so-called rubber mats are good insulators.

Equipment containing metal parts, such as brushes and brooms, should not be used in an area within 4 feet of high voltage circuits or any electric wiring having exposed surfaces.

Inform remote stations as to the circuit on which work is being performed.

Keep clothing, hands, and feet dry if at all possible. When it is necessary to work in wet or damp locations, use a dry platform or wooden stool to sit or stand on, and place a rubber mat or other nonconductive material on top of the wood. Use insulated tools and insulated flashlights of the molded type when required to work on exposed parts.

Do not wear loose or flapping clothing. The use of thin-soled shoes with metal plates or hobnails is prohibited. Safety shoes with nonconducting soles should be worn if available. Flammable articles, such as celluloid cap visors, should not be worn.

When working on an electrical apparatus, technicians should first remove all rings, wristwatches, bracelets, ID chains and tags, and similar metal items. Care should be taken that the clothing does not contain exposed zippers, metal buttons, or any type of metal fastener.

Do NOT work on energized circuits unless absolutely necessary. Be sure to take time to lock out (or block out) the switch and tag it. Locks for this purpose should be readily available; if a lock cannot be obtained, remove the fuse and tag the fuse box.

Use one hand when turning switches on or off. Keep the doors to switch and fuse boxes closed except when working inside or replacing fuses. Use a fuse puller to remove cartridge fuses after first making certain that the circuit is dead.

All supply switches or cutout switches from which power could possibly be fed should be secured in the OPEN (safety) position and tagged. The tag should read "THIS CIRCUIT WAS ORDERED OPEN FOR REPAIRS AND SHALL NOT BE CLOSED EXCEPT BY DIRECT ORDER OF ____" (the person making, or directly in charge of, repairs).

Never short out, tamper with, or block open an interlock switch.

Keep clear of exposed equipment; when it is necessary to work on it, use one hand only as much as possible.

Warning signs and suitable guards should be provided to prevent personnel from coming into accidental contact with high voltages.

Avoid reaching into enclosures except when absolutely necessary; when reaching into an enclosure, use rubber blankets to prevent accidental contact with the enclosure.

Do not use bare hands to remove hot parts from their holders. Use asbestos gloves if necessary.

Use a shorting stick, similar to the one shown in figure 1-1 to discharge all high voltage charges. Before a worker touches a capacitor or any part of a circuit which is known or likely to be connected to a capacitor (whether the circuit is de-energized or disconnected entirely), he should short circuit the terminals to make sure that the capacitor is completely discharged. Grounded shorting sticks should be permanently attached to work-benches where electrical equipment using high voltages are regularly serviced.

Make certain that the equipment is properly gounded. Ground all test equipment to the equipment under test.

Turn off the power before connecting alligator clips to any circuit.

When measuring circuits over 30 volts, do not hold the test prods.

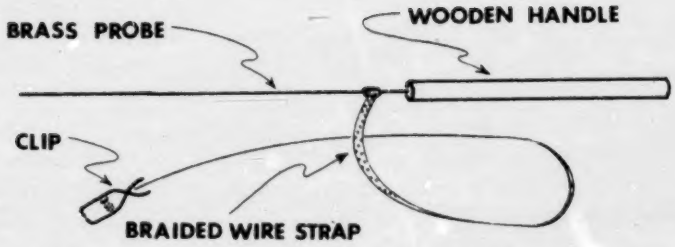


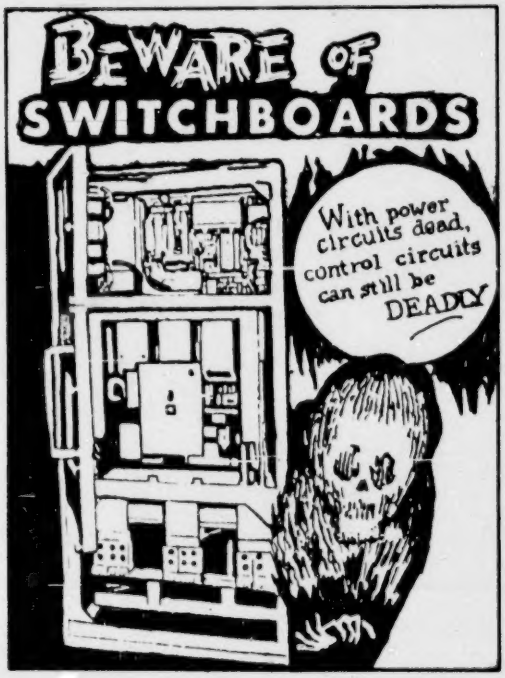
Figure 1-1. Shorting Stick

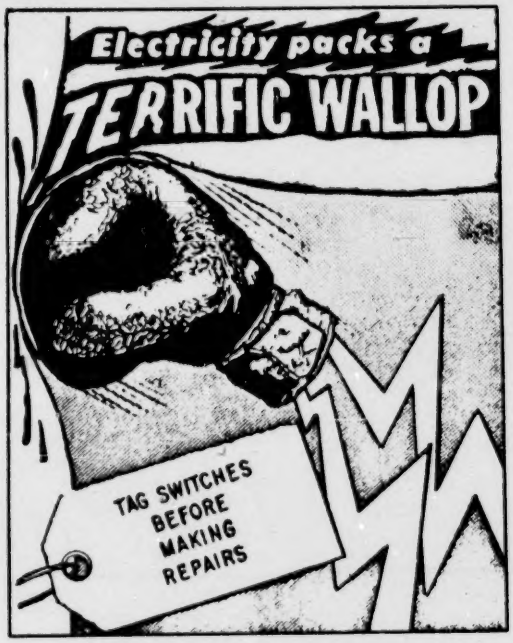
Safety Education

Safety is an all-hands responsibility. It is the job of every person in the Navy to exercise caution to insure that people will not be injured or killed, or equipment damaged or ruined. Safety information is presented in many different ways - for example: (1) written material, as given in this lesson; (2) safety bulletins; (3) lectures; (4) movies; (5) courses in first aid; and (6) posters.

Every shop in which you work should emphasize safety. One of the ways in which this can be done is through the use of posters. The Navy makes available numerous safety posters. Some of these are general in nature and some relate to specific types of work. These posters should be placed in a conspicuous area and as new ones are printed they should replace the older ones.

Four of the current posters that relate to shop and electrical safety are depicted on the next page.





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NAVPERS 94558-0a

BASIC ELECTRICITY AND ELECTRONICS
INDIVIDUALIZED LEARNING SYSTEM

M O D U L E Z E R O
L E S S O N V I

Building Your Power Supply

Study Booklet

Bureau of Naval Personnel
January 1972

ORIENTATION

LESSON VI

Building Your Power Supply

Using the instructions provided herein, we want you to construct your own power supply before you start your formal study of Basic Electricity and Electronics.

Note that you have been furnished a board with several large electrical components mounted on it, a small box containing various electrical components and hookup wires. Place these items in front of you.

Before you put the components together, let us briefly discuss what a power supply is. As its name implies, it is a supplier of power; in this case a supplier of electrical power. The power supply you will build is a miniature example of a power supply of the sort that supplies electrical power for radios, televisions, amplifiers, and motor controllers.

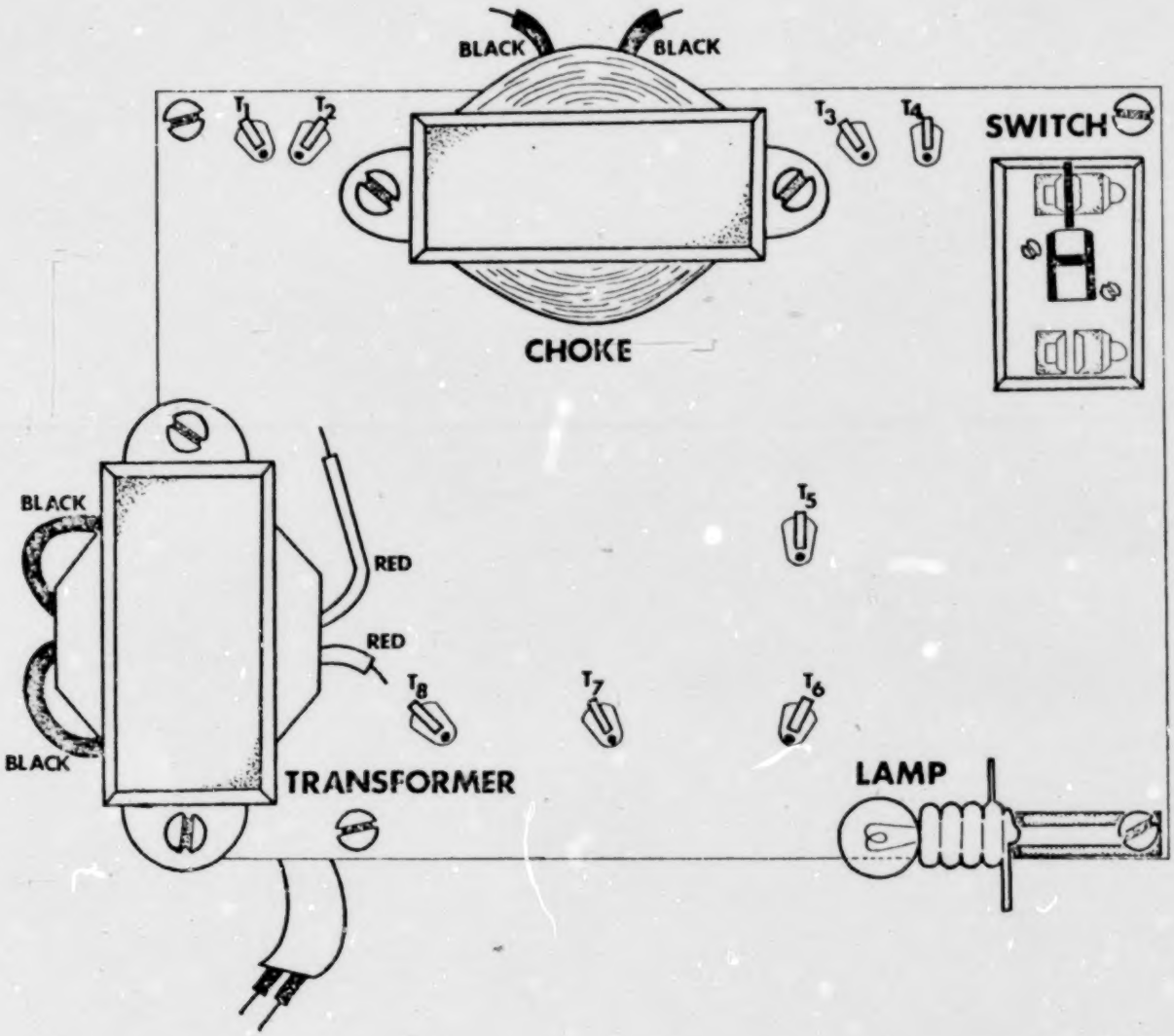
You will work with the same power supply throughout this course. As you progress, you will be referring to your power supply and its components continually. Before you complete the course, you will have a solid working knowledge of the functions and operational characteristics of the power supply and each of its components.

For now, however, we simply want you to build the power supply. You will not be graded on your performance.

You will now start putting the power supply together. Follow the instructions and should problems arise, call your learning supervisor.

Comparing your power supply to FIGURE A (next page), note that the components labeled as transformer, switch and lamp base are already installed on the board. Note also that the power supply contains eight spring-loaded connectors labeled T1 - T8. These are operated by pressing down on the highest part.

FIGURE A



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Step 1. Spread the components before you. First pick out a component that has color bands around the body; the particular one you are looking for is colored Yellow-Violet-Gold (always start with the color closest to the end of the body). Connect one end of this component and the long red lead from the transformer to terminal T1 on the board. Connect the other end of the component to T2.

When wiring up components, make nice neat bends in all wires. Should you need assistance, see your learning supervisor.

Your power supply should now look like Figure #1 (next page).

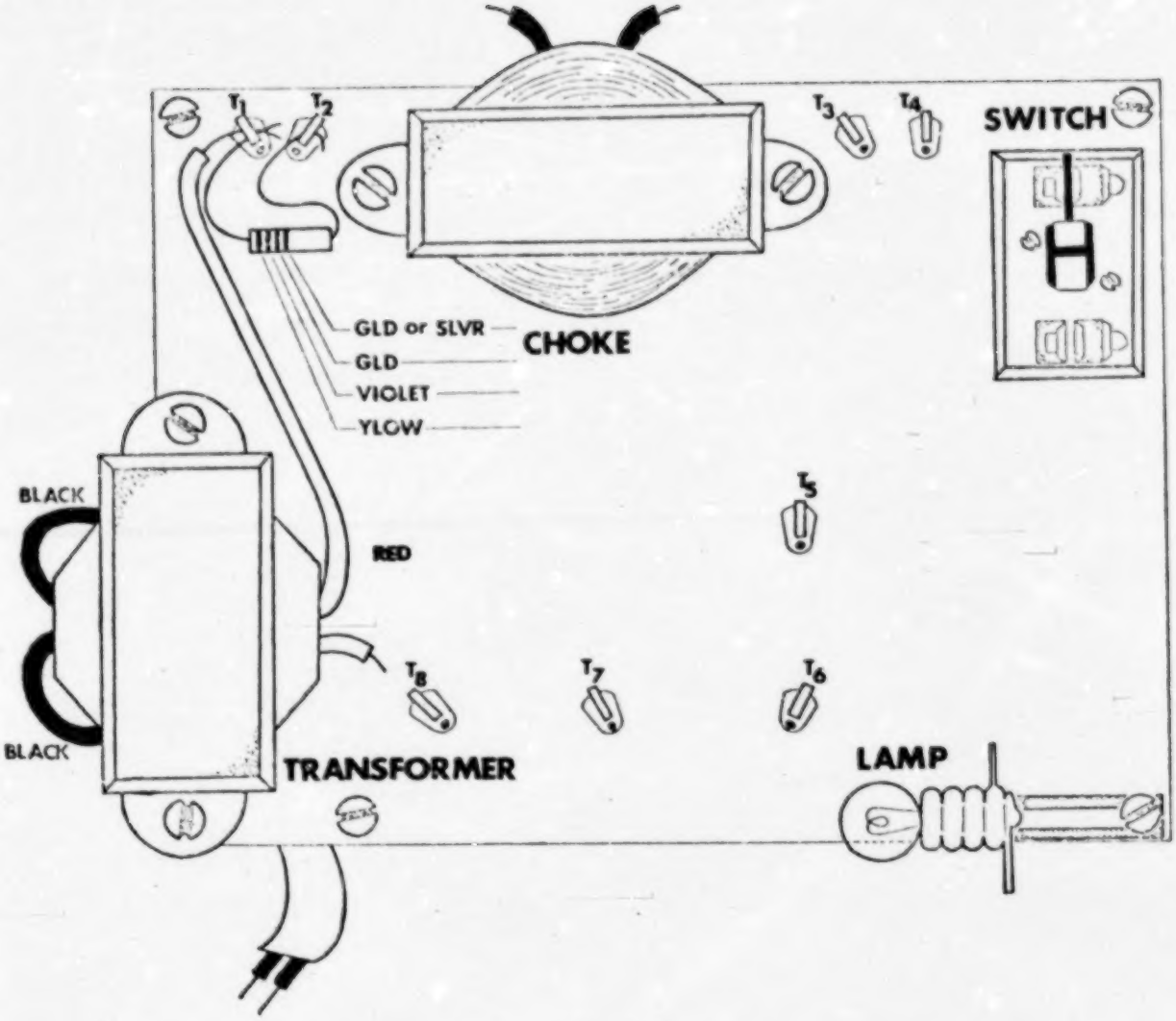

FIGURE 1.

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Step 2. Connect one black lead from the choke that is mounted on the board and connect to T2. The other black lead from the choke is to be connected to T3.

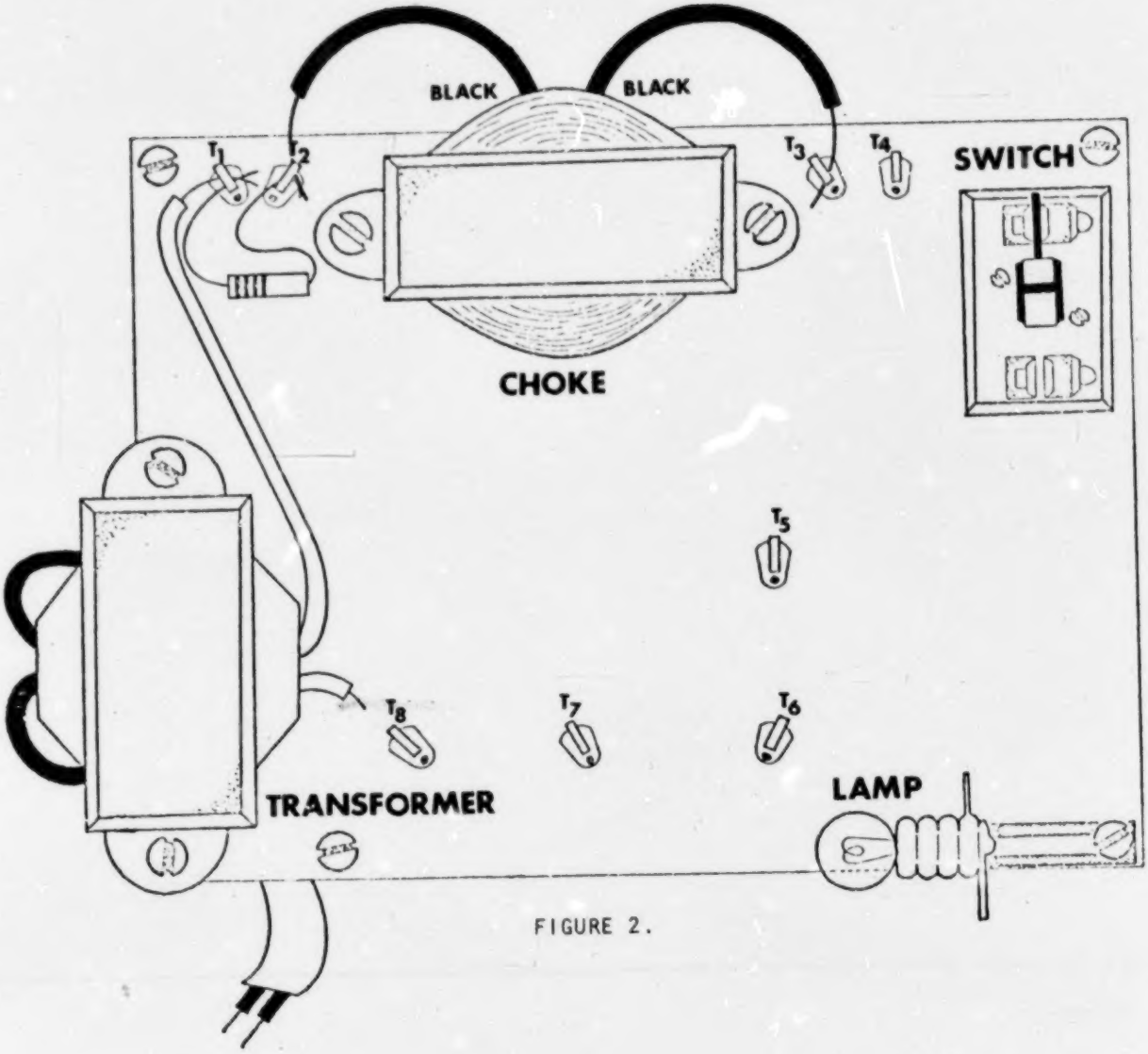

FIGURE 2.

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Step 3. Next select another component with bands that are colored Yellow-Violet-Gold (again, start with the color nearest the end). Insert this component between terminal T3 and T4.

Now check your work against Figure #3 (next page).

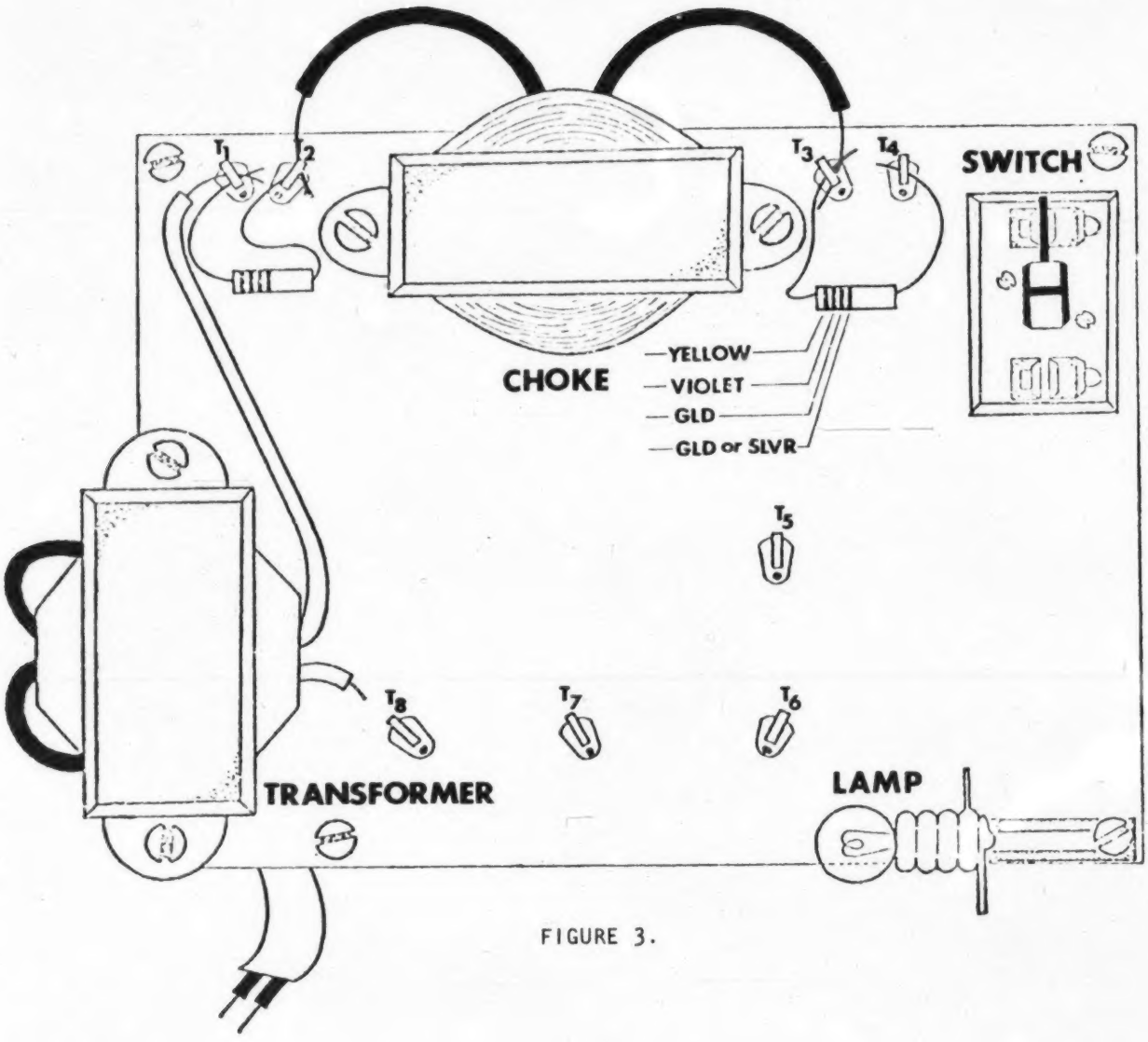

FIGURE 3.

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Step 4. Select a component with color bands of Brown-Black-Red. This component is inserted between terminal T4 and T5.

Check your work against Figure #4 (next page).

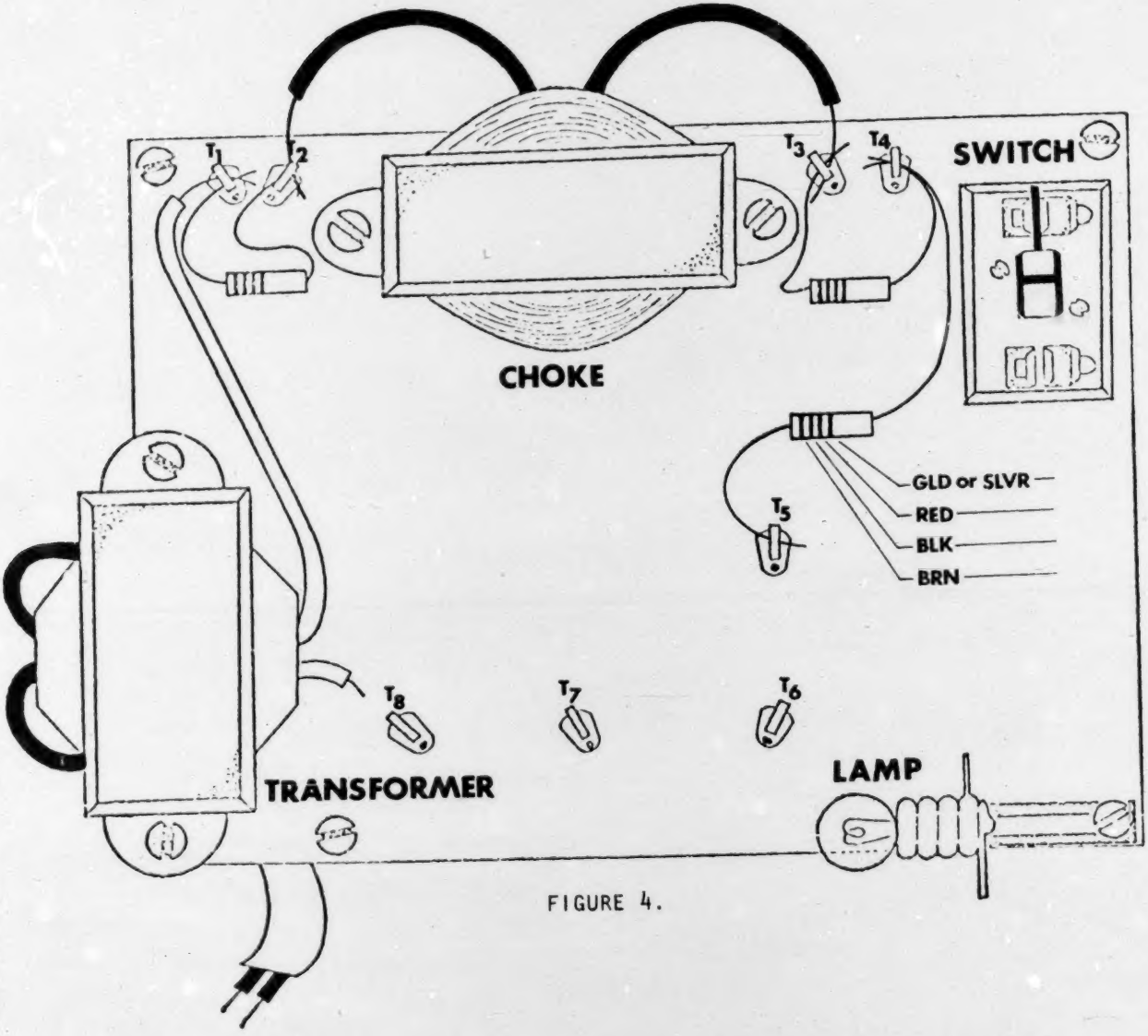

FIGURE 4.

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Step 5. Find the last color-banded component, again Brown-Black-Red, and connect it from terminal T5 and T6.

Check your work against Figure #5 (next page).

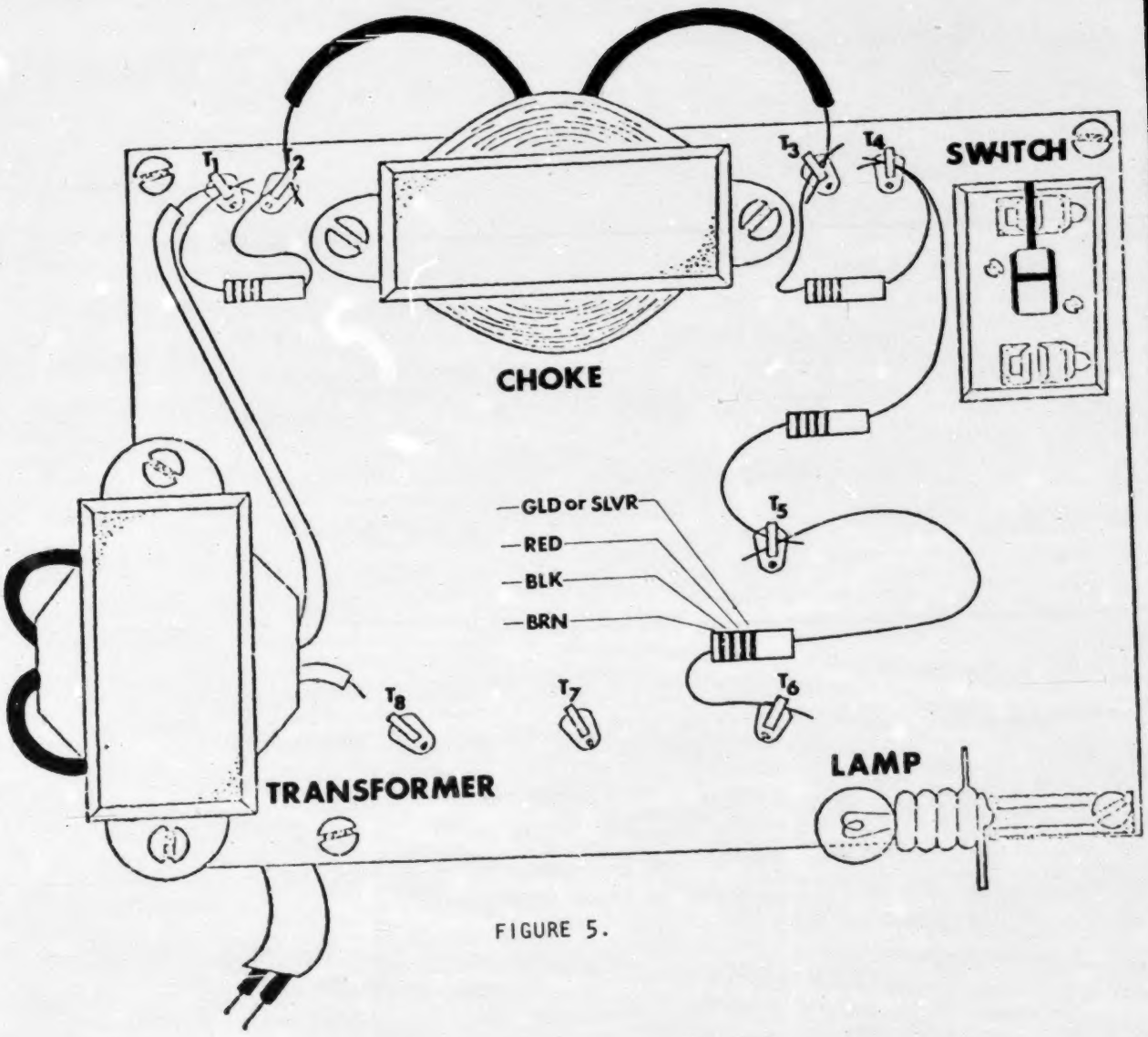

FIGURE 5.

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Step 6. The next component to be installed is the capacitor. It has a plus sign printed on the body. Connect it between T2 and T7. Make sure the (+) positive sign on the component is nearest to T2.

Check your work against Figure #6 (next page).

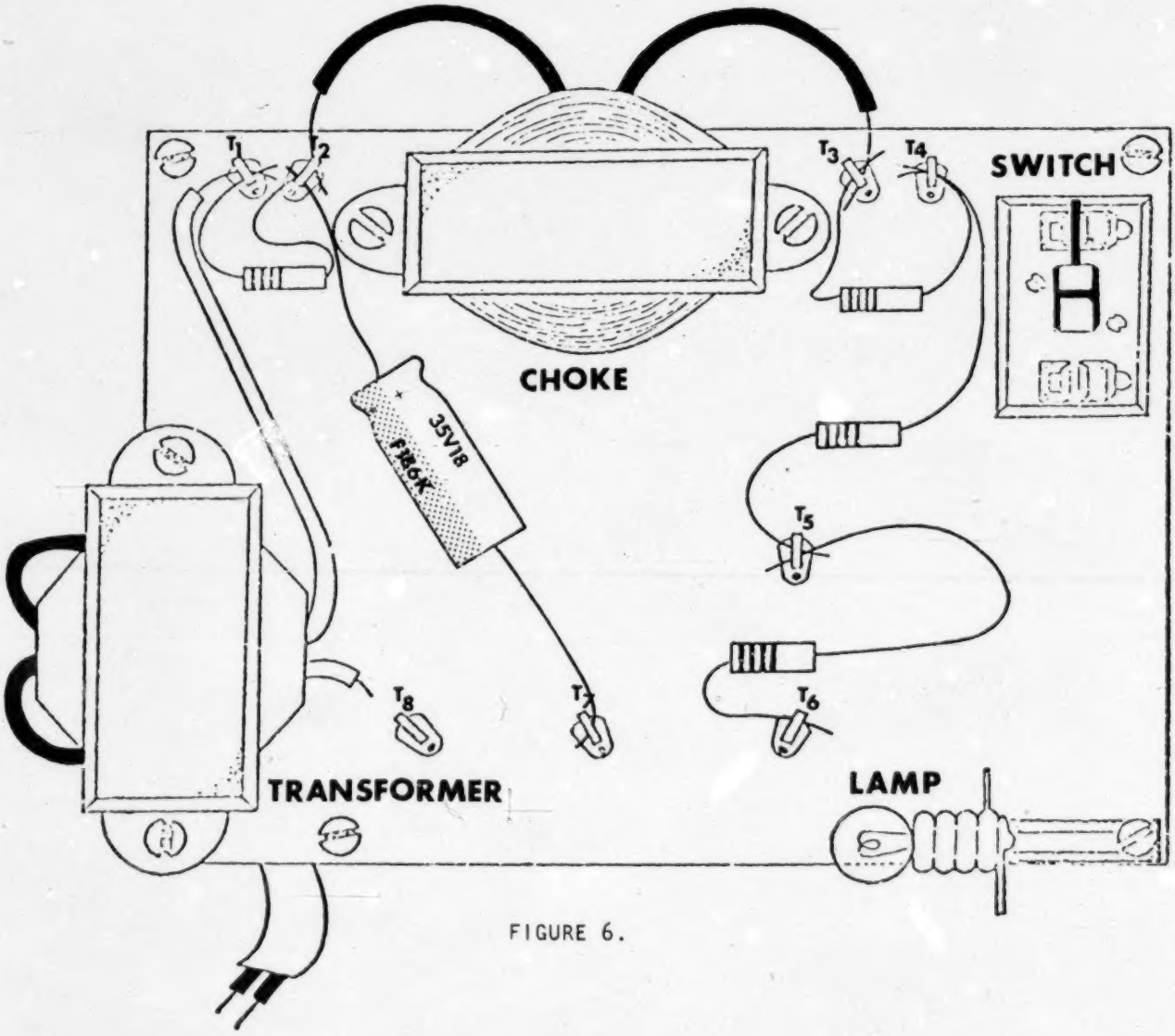

FIGURE 6.

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Step 7. Take the other capacitor and connect it between T3 and T7. Make sure the (+) positive sign is nearest T3.

Check your work against Figure #7 (next page).

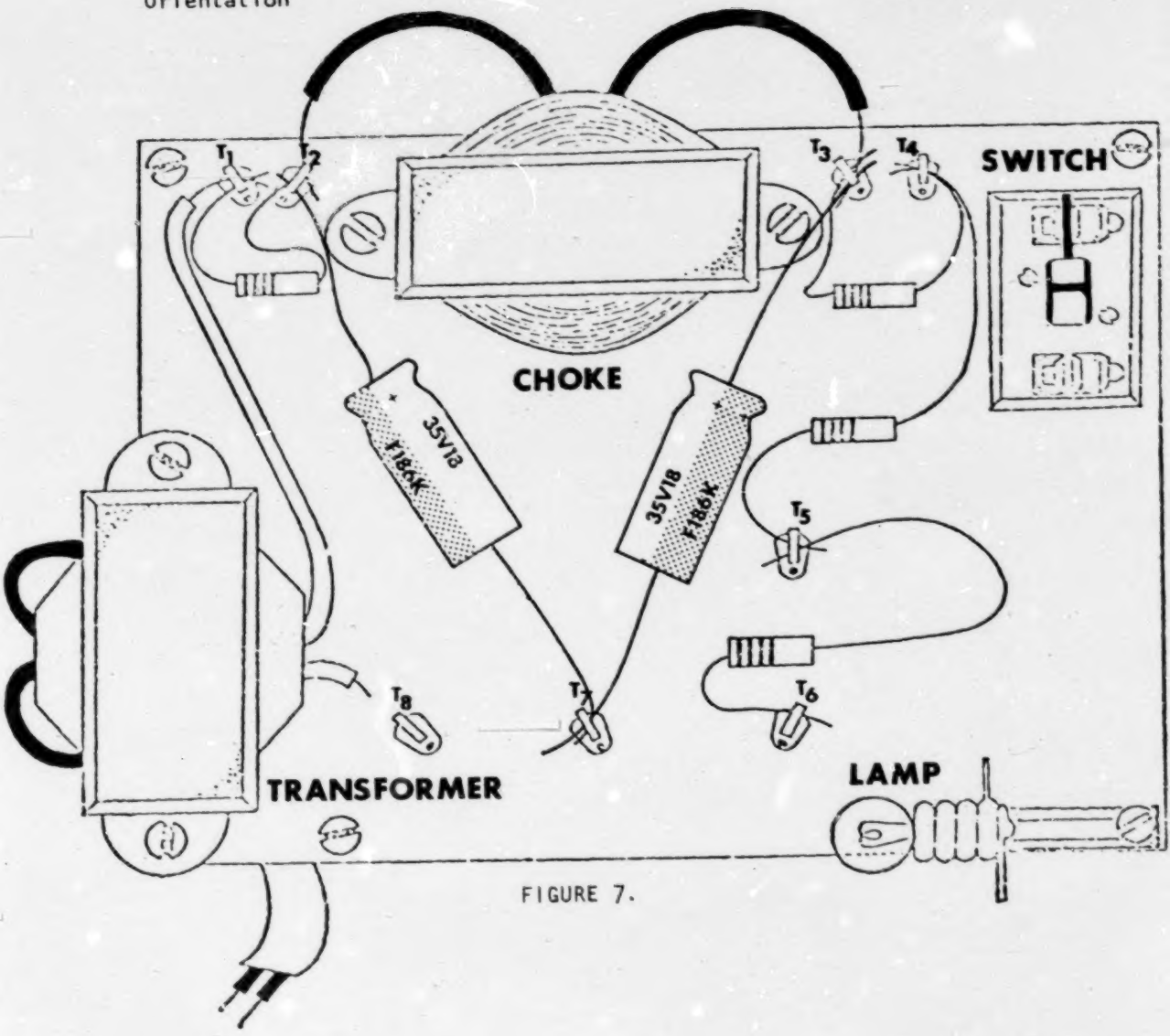

FIGURE 7.

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Step 8. Next take the component that has the symbol IN 4001 printed on the body. Connect it between T7 and T8. Make certain the silver or black band on the diode is connected to T8.

Check your work against Figure #8 (next page).

NOTE: USE EXTREME CAUTION WHEN CONNECTING DIODE IN-4001. IF THE DIODE IS INCORRECTLY CONNECTED, IT WILL RESULT IN THE EXPLOSION OF THE TWO CAPACITORS AND CAUSE POSSIBLE PERSONAL INJURY!!!!

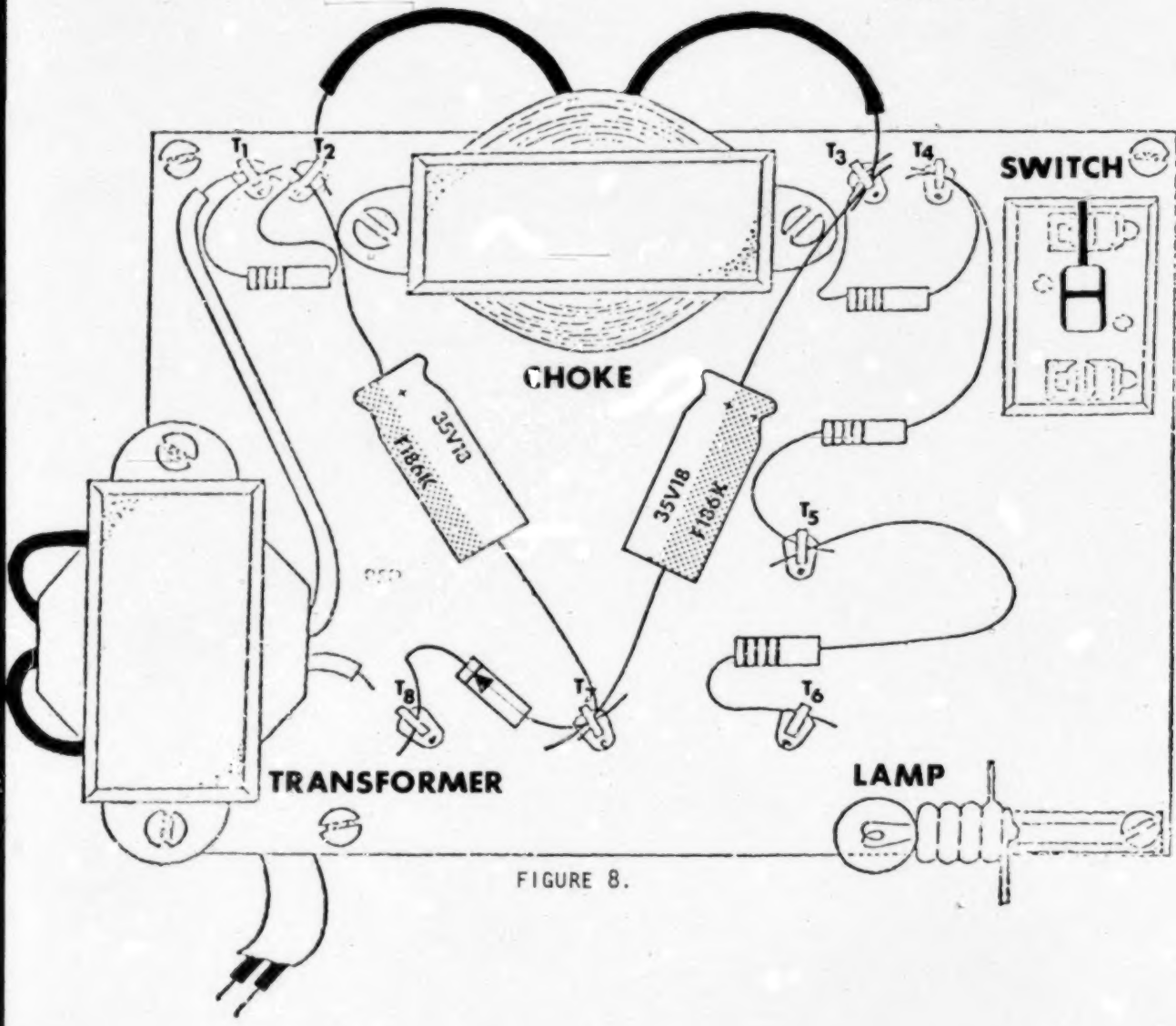

FIGURE 8.

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Step 9. Now select a short piece of white wire from your supply of parts and insert it between terminal T7 and T6.

Note: When working with hookup wire put in nice neat wire bends.

Check your work against Figure #9 (next page).

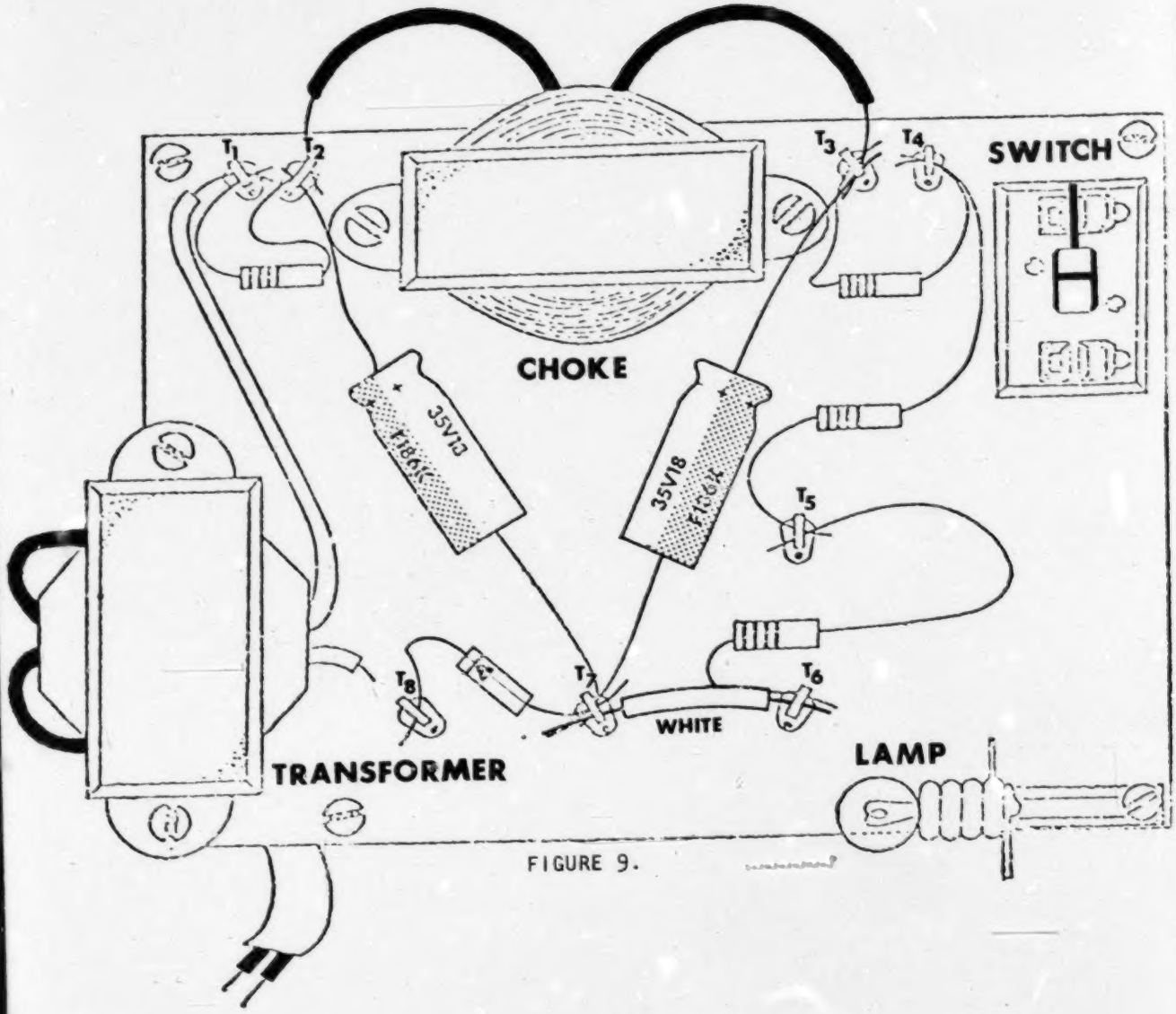

FIGURE 9.

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Step 10. Now connect a white lead from Side "A" of the switch to terminal T4; connect the blue wire from the lamp socket to terminal T6. Connect the wire from the other side of the lamp socket to the "B" side of the switch. From the center of the transformer select the short red wire and connect it to terminal T8.

Check these connections against Figure #10 (next page).

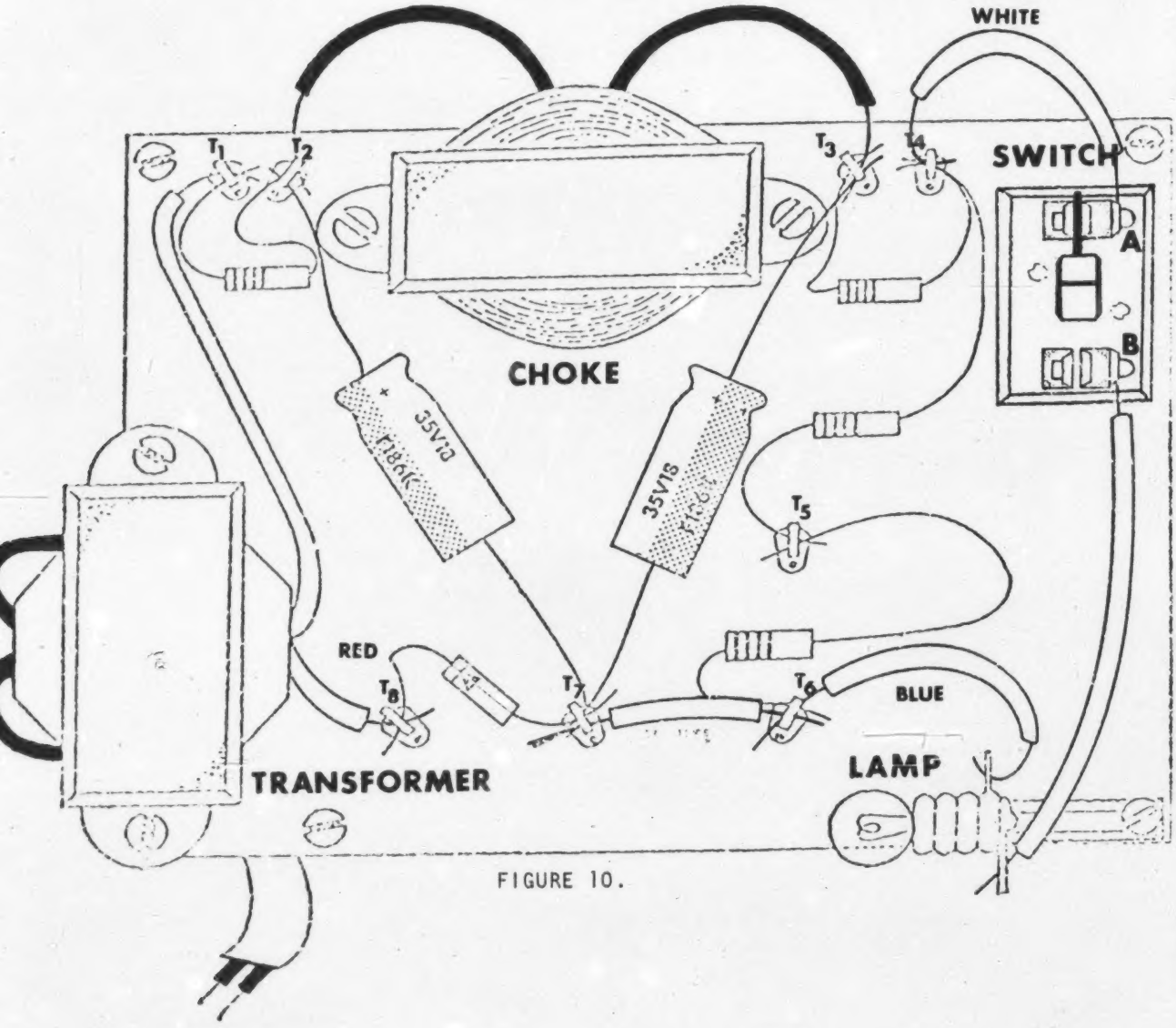

FIGURE 10.

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Step 11. Everything is connected and the circut is ready for operation; first carefully check your power supply against Figure #10. When you are satisfied that the power supply is correct, take power supply to Learning Supervisor for final check. Before energizing, make sure the switch is in the open position. Now plug your power supply in. Close the switch. Congratulations, you have built a power supply. Your lamp should light (see Figure #11 on the next page). If not, see your learning supervisor. Remove plug from socket and leave power supply assembled.

Now think about this: you have a complete power supply with components; what is the purpose of all those different components, how do they work, what is their function, what are they called, and are they really necessary? In short, what do you know about what you have just completed building.

Obviously, unless you have previous experience in electricity, you do not know the answers to these questions. It is one of the purposes of this course to provide you with the answers.

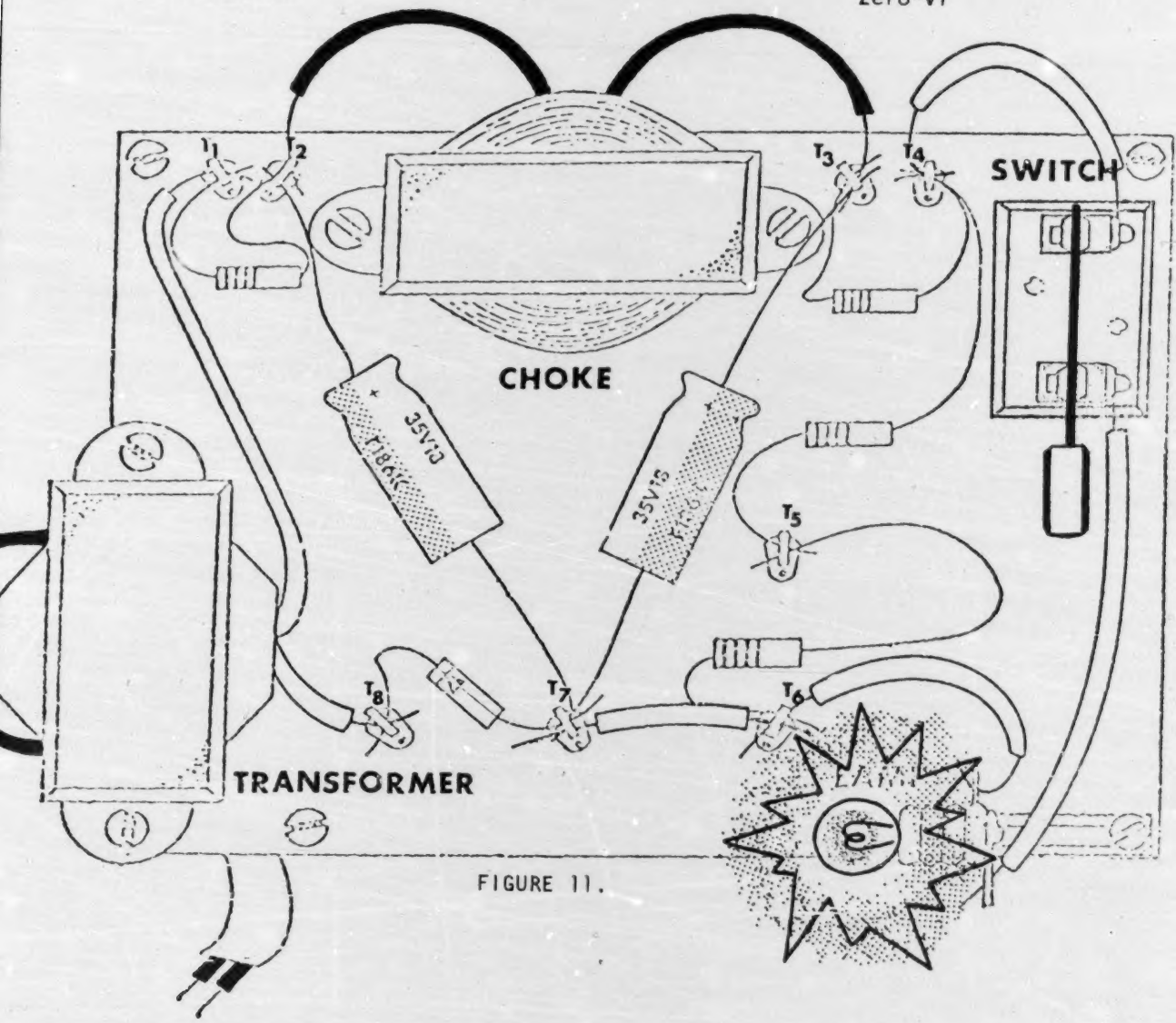

FIGURE 11.

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THERE IS NO MODULE TEST FOR MODULE ZERO. NOW THAT YOU HAVE SUCCESSFULLY COMPLETED YOUR POWER SUPPLY, YOU ARE READY TO BEGIN MODULE ONE. DRAW YOUR MODULE ONE BOOKLET FROM THE FILE CABINETS IN THE MATERIAL CENTER AND BEGIN WORK.